SAARC Energy Centre, Islamabad

Pakistan

THE REPORT

Webinar on "How Users can Save on Their Electricity Bills"

28th July 2020, Islamabad

Organized by:
SAARC Energy Centre

July 28, 2020

SAARC Energy Centre
697, Street 43, Sector E-11/4 (NPF),
Islamabad, Pakistan
www.saarcenergy.org

Introduction

1. SAARC Energy Centre, Islamabad successfully conducted a Webinar on "How Users can Save on Their Electricity Bills" on Tuesday, 28th July 2020. Webinar Agenda is available at Annexure-I.

2. Focus of the webinar was to make the audience appreciate the importance of energy conservation and efficient usage of energy, and the resulting economic benefits for the consumers. The topics discussed during the webinar were: energy conservation in industrial and commercial sectors, energy audit process and initiatives taken by K-Electric to promote energy conservation.

Participation

3. The webinar was attended by 33 professionals representing public and private sector organizations, academia, and research institutes within and outside SAARC region. The experts from India and Pakistan shared their knowledge pertaining to various ways to conserve energy and minimise its wastage. The participants list is available at Annexure-II.

Description

4. The webinar began with the welcome remarks by Program Coordinator, Mr. Ahmad Talha, Research Fellow (Technology Transfer) of SAARC Energy Centre. The technical session comprised of presentations by the expert speakers. Each presentation was followed by a brief Q & A session. The Program Coordinator read out conclusions, which were gathered during the webinar. Before closing the webinar, the Program Coordinator from SAARC Energy Centre offered remarks of appreciation to all the participants and presenters.

Technical Proceedings

5. Two resource persons from India and Pakistan shared their knowledge in the webinar. All the presentations delivered during the webinar are available at SEC's website (https://www.saarcenergy.org/webinar-on-how-users-can-save-on-their-electricity-bills/). Details of Resource Persons are available at Annexure-III and their Presentations at Annexure-IV. A brief information on the content of the delivered presentations is as follows:

Presentation 1 – Electricity Saving Opportunities in Industrial and Commercial Sectors

Mr. G. Srinivasa Rao, Director, East Coast Sustainable (Pvt.) Ltd., India.

6. Mr. Srinivasa Rao is currently working as Director of East Coast Sustainable. He has got experience in the energy sector covering technical, commercial and regulatory aspects of power generation, transmission and distribution of electricity and energy efficiency. He has also consulted industries to optimize their energy cost, improving performance of various industry sectors such as thermal power plants, cement, iron & steel, fertilizers, pharmaceutical, municipalities, commercial buildings. His expertise includes technical consulting, financial engineering, transactional advisory, project management for implementing energy efficient solutions, electricity tariffs and regulations.

7. In his presentation, he started by sharing the current energy generation and consumption scenario in India. He shared his knowledge on benchmarking the energy efficiency figures of various industrial sectors against global average and best available technology. He presented the key points of Indian Energy Conservation Act 2001 including Energy Conservation Building Code (ECBC), the standards followed for equipment labelling and minimum required efficiency of different equipment.

8. He highlighted some important technologies used in the industrial sector to reduce energy wastage in electrical and thermal equipment with relevant case studies to show the resulting energy savings. He enlightened the audience regarding the importance of energy conservation in residential and commercial buildings and major energy consumers in buildings.

Presentation 2 – Energy Efficiency

Mr. Syed Waqas Arshad, Lead Energy Conservation, K-Electric, Pakistan.

9. Mr. Waqas has professional experience in electric utility, and energy management solutions. At K-Electric, he currently works in the energy conservation and efficiency team, managing energy audits and energy management systems as per ISO 50001 guidelines for internal and external stakeholders. He also worked on various projects across Pakistan related to energy efficiency, energy management, building management and lighting control systems. Mr. Waqas has recently worked on Leadership in Energy and Environmental Design (LEED) projects as well.

10. K-Electric is the only vertically integrated power utility in Pakistan, which powers Karachi. Mr. Waqas focused his presentation on the initiatives taken by Energy Conservation Department of K-Electric to facilitate their consumers in reducing their energy consumption. He explained the process of energy audit carried by K-Electric and the support provided by K-Electric to help their customers comply ISO 50001 requirements.

11. Mr. Waqas shared the case studies of some customers of K-Electric highlighting the achieved savings in energy consumption, reduction in CO_2 emissions and resultant monetary benefits based on the solutions suggested during the energy audit. He also presented the steps by K-Electric to reduce energy consumption of its own power plants and commercial buildings. He shed some light on the power factor improvement programme of K-Electric. Improving the power factor reduces network load and losses as well as saves customers from paying hefty penalties imposed due to low power factor. He concluded his presentation with some general energy conservation guidelines for commercial consumers.

Wrap up and Conclusion

Mr. Ahmad Talha, Research Fellow (Technology Transfer), SAARC Energy Centre

12. Mr. Ahmad Talha thanked the speakers for sharing their knowledge on the importance of energy conservation and energy efficiency, and the resulting benefits for the consumers as well as our environment. The following conclusions were drawn from the discussion of this webinar:

a. Energy audits can help the consumers to identify the areas of improvement. Higher efficiency motors, variable frequency drives, LED lighting, efficient cooling and heating solutions and energy management systems can help reduce energy wastage in commercial and industrial sectors.

b. Consumers also need to be vigilant about maintaining a higher power factor. Improved power factor can result in multiple benefits for the network such as lower network load and losses, better voltage regulation and system stability as well as result in financial savings for the consumers.

Closing of Webinar

Mr. Ahmad Talha, Research Fellow (Technology Transfer), SAARC Energy Centre

13. Mr. Ahmad Talha, informed all the participants that the presentations and recording of the webinar proceedings would be available on SAARC Energy Centre's website (www.saarcenergy.org). He closed the webinar with a thank you note to everyone attending the Webinar.

Annexures

Annexure-I

Webinar Agenda

Webinar on
"How Users can Save on Their Electricity Bills"
Tuesday, 28th July 2020

1100 – 1105	Introduction
1105 – 1135	**Importance of Energy Conservation for Consumers** *Mr. G. Srinivasa Rao, Director, East Coast Sustainable Pvt. Ltd., India.*
1135 – 1150	Q & A session
1150 – 1220	**Energy Efficiency** *Mr. Syed Waqas Arshad, Lead Energy Conservation, K-Electric, Pakistan.*
1220 – 1235	Q & A session
1235 – 1240	Conclusion and Recommendations
1240 – 1245	Closing of Webinar

Information for the participants:

1. All times mentioned in agenda are according to Pakistan Standard Time (PKT). The participants from other Member States may attend Webinar by following their own national time. The time conversion for all Member States is given below for reference:

Country	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Sri Lanka
Local time	(PKT-00:30)	(PKT+01:00)	(PKT+01:00)	(PKT+00:30)	PKT	(PKT+00:45)	(PKT+00:30)

2. The participants can ask questions to presenters by typing questions or clicking the 'raise hand' option under Attendees tab of the main window of GoToWebinar software. You may send in your questions at any time during the presentations; we will collect these and address them during the Q&A session at the end of each presentation.

3. All participants can also submit comments/views and/or observations on the draft study report to SAARC Energy Centre through email to Mr. Ahmad Talha, Research Fellow (TT) (rftt@saarcenergy.org).

List of Participants

Sr. No.	First Name	Last Name	Email address
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Annexure-II

Sr. No.	First Name	Last Name	Email address
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31.	Nima	Zangmo	zangmo450@gmail.com
32.	Farid	Alam	farid.alam@asiafoundation.org
33.	Shayan	Arif	shayan.arif@ke.com.pk

Annexure-III

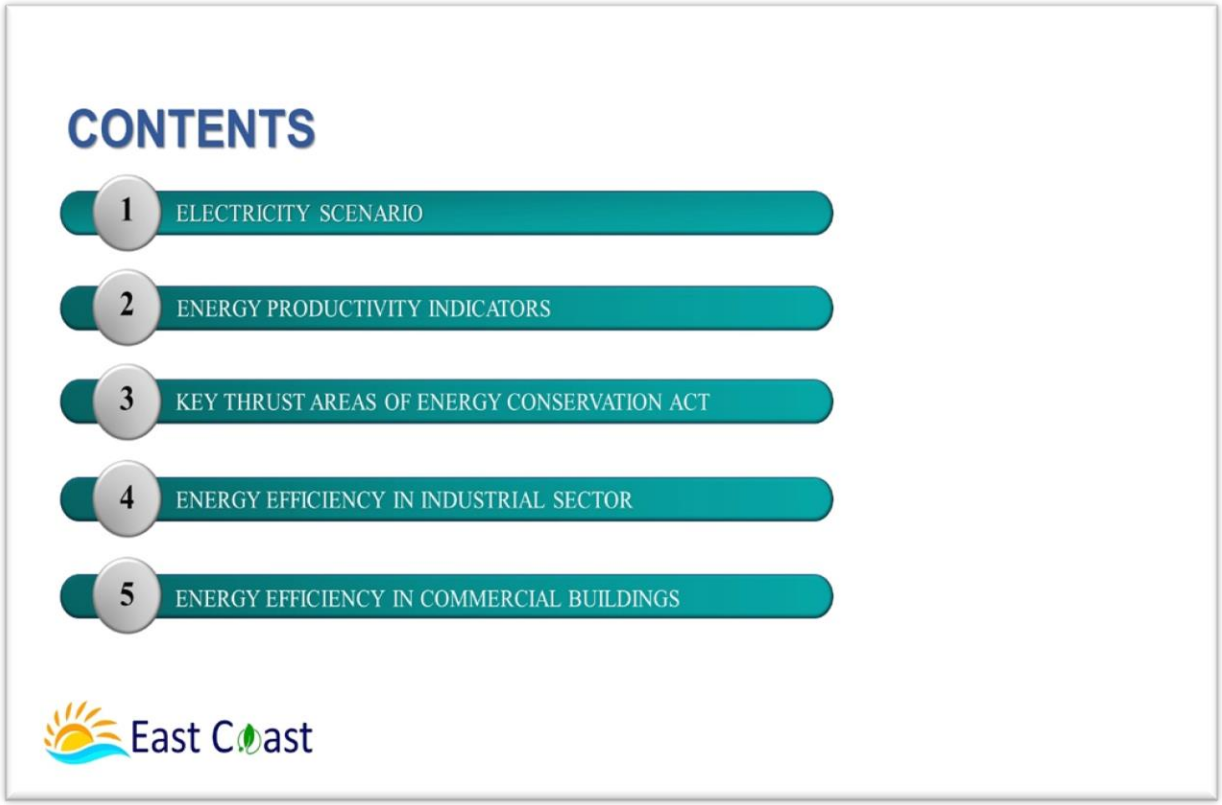
List of Presenters/Resource Persons

Sr. No.	Name	Designation	Organization	Email address
1.	Mr. G. Srinivasa Rao	Director	East Coast Sustainable Pvt. Ltd., India.	srinivasa.gandepalli@eastcoast.net.in
2.	Mr. Syed Waqas Arshad	Lead Energy Conservation	K-Electric, Pakistan.	waqas.arshad@ke.com.pk

Presentations Delivered During the Webinar

1. **"Electricity Saving Opportunities in Industrial and Commercial Sectors" by Mr. G. Srinivasa Rao,**

   Director, East Coast Sustainable Pvt. Ltd., India.



ELECTRICITY SCENARIO

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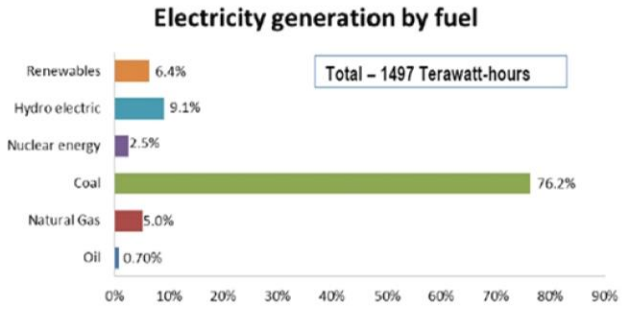
ELECTRICITY

1 Introduction



- India is the world's third largest producer and consumer of electricity with capacity of 344 GW as on 31 May 2018.
- India's electricity sector is dominated by coal-based power plant for meeting about 76.2% of all electricity.

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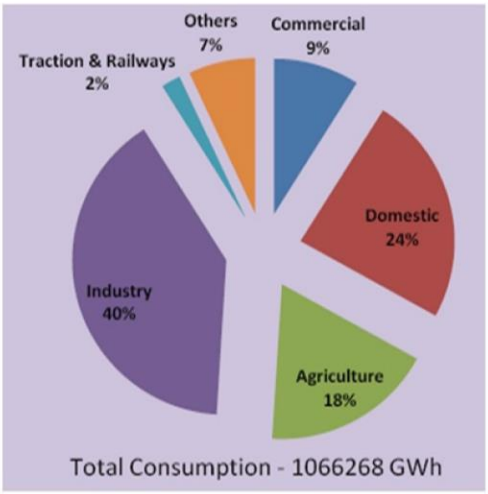
ELECTRICITY



2 Electricity consumption

- The overall plant load factor (PLF) of all thermal power plants is only about 65%.
- Industry dominates electricity consumption (40%) followed by domestic (24%) and agriculture (18%).

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ENERGY PRODUCTIVITY INDICATORS

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1 Benchmarking of Sectoral Energy Efficiency

- Benchmarking is the process of accounting for and comparing a metered industrial facility's current energy performance with its energy baseline or with the energy performance of similar types of industry. The United Nations Industrial Development Organization (UNIDO).
- benchmarked the energy efficiency potential for 26 industrial sub-sectors globally by looking at sector specific indicators of performance in terms of energy per unit of output (UNIDO 2010) (refer Table on the next slide).
- The study broke down the results in developing and developed countries and also presented figures for the global average, the lowest found in the sample and the achievable performance using Best Available Technology (BAT).

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2 Benchmarking of Sectoral Energy Efficiency

Table: Specific Energy Consumption in Industry – India and the World

Sector	Unit	Industrialized Country	Developing Country	Global Average	Best available Technology	India
Petroleum refineries (2003)	*Energy Efficiency Index (EEI)*	*0.7 – 0.8*	*1.3 – 3.8*	*1.25*	*1*	*0.9*
High Value (HVC)	*Gj/t HVC*	*12.6 – 18.3*	*17.1 – 18.3*	*16.9*	*10.6*	*17.1*
Ammonia (2007)	*Gj/t NH3*	*33.2 – 36.2*	*35.9 – 46.5*	*41*	*23.5*	*37.5*
Methanol (2006)	*Gj/t MeOH*	*33.7 – 35.8*	*33.6 – 40.2*	*35.1*	*28.8*	*40.2*
Aluminium Smelting (2007)	*MWh/t*	*14.8 – 15.8*	*14.6 - 15*	*15.5*	*13.4*	*16*

2 Benchmarking of Sectoral Energy Efficiency

Table: Specific Energy Consumption in Industry – India and the World

Sector	Unit	Industrialized Country	Developing Country	Global Average	Best available Technology	India
Alumina Production	*Gj/t alumina*	*10.9 – 15.5*	*10.5 – 24.5*	*16*	*7.4*	--
Iron & Steel (2005)	*Gj/t steel*	*1.6 – 1.4*	*1.4 - 2.2*	*1.45*	*1*	*1.55*
Clinker (2007)	*Gj/t clinker*	*3.3 – 4.2*	*3.1 – 6.2*	*3.5*	*2.9*	*3.1*
Cement (2007)	*Gj/t cement*	*109 - 134*	*92 - 121*	*109*	*56*	*92*
Lime	*Gj/t lime*	*3.6 - 13*	*5 - 13*	--	--	*5.6*
Glass (2005)	*Gj/t melt*	*4 - 10*	*6.8 - 7.8*	*6.5*	*3.4*	*6.8*
Brick making (2000s)	*Gj/kg fired brick*	*1.5 - 3*	*0.75 - 11*	--	--	*3 - 11*

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2 Benchmarking of Sectoral Energy Efficiency

Table: Specific Energy Consumption in Industry – India and the World

Sector	Unit	Industrialized Country	Developing Country	Global Average	Best available Technology	India
Pulp & Paper	*EEI (heat & electricity)*	*0.93 – 1.73*	*0.43 – 2.29*	*1.31*	*1*	--
Textiles - Spinning	*Gj/t yarn*	*3.5 – 3.6 (ring yarn)* *2.57 (open end)*	*3.5 – 3.6 (ring yarn)* *0.5 – 7.5 (other)*	--	--	*3.57 (ring yarn)* *2.5 (other)*
Textiles - Weaving	*Gj/t cloth*	*11 – 65*	*5 - 43*	--	--	*27 – 32.4*

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2 Benchmarking of Sectoral Energy Efficiency

Table: Specific Energy Consumption in Industry – India and the World

Sector	Unit	Industrialized Country	Developing Country	Global Average	Best available Technology	India
Cast Iron	*kWh/t melt*	*950 (cupola)* *525 – 715 (electric)*	*780 – 850* --	-- --	*520* --	*780 – 900* --
Cast/ alloy steel	*kWh/t melt*	*525 – 715 (electric)*	--	--	--	--
Cast aluminium	*kWh/t melt*	*600 – 1250 (fuel fired)* *440 – 590 (electric)*	*735* *590*	-- --	*500* *570*	*735* --
Cast copper	*kWh/t melt*	*400 – 1100 (electric)*	*590*	--	*400*	*590*

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KEY THRUST AREAS OF ENERGY CONSERVATION ACT, 2001

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KEY PROVISIONS OF EC ACT 2001

1 Standard

- Energy-efficiency standards are procedures and regulations that prescribe limits on the energy consumption of manufactured products.
- Intention is to prohibit the sale of products that are less energy efficient than the minimum prescribed standards, called as Minimum Energy Performance Standards (MEPS).

2 Standard

- Energy-efficiency labels are information affixed to manufactured products and usually communicate the product energy performance.

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KEY PROVISIONS OF EC ACT 2001

2 Comparative Labels

Products notified under mandatory labelling

As of Sep. 2018, the following products have been notified under mandatory labelling:

1. Frost Free (no-frost) refrigerators	6. Direct Cool Refrigerators
2. Tubular Fluorescent Lamps	7. Electric Geysers
3. Room Air Conditioner	8. Color TV
4. Distribution Transformers	9. Room Air Conditioners (Inverter type)
5. Room Air Conditioner (Cassette, Floor Standing Tower, Ceiling, Corner, Corner AC)	10. LED lamps

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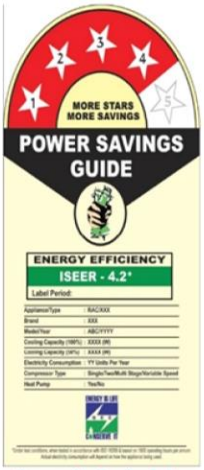
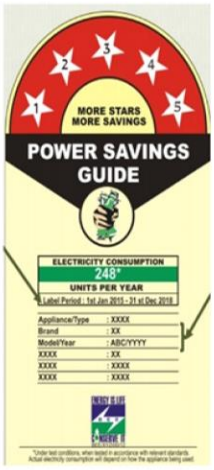
KEY PROVISIONS OF EC ACT 2001

2 Comparative Labels



Sample Label for Air Conditioners

Sample Label for LED lamps



Sample Label for Refrigerator

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KEY PROVISIONS OF EC ACT 2001

3 ECBC

Purpose

- Energy Conservation Building Code (ECBC) encourage energy efficient design of buildings without affecting the building function, comfort, health, or the productivity of the occupants.
- ECBC also addresses local design conditions and helps improve existing construction practices.
- The emphasis of BEE is on Integrated Building Design approach.
- ECBC is also easy to use and encourages continuous improvisations.
- The code was revised and updated in 2017 to match with the technology developments to set higher benchmarks for energy efficiency.

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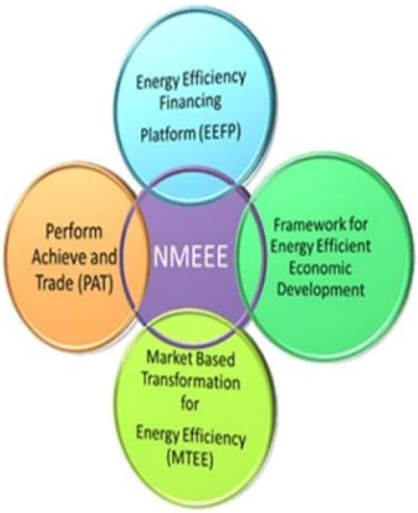
KEY PROVISIONS OF EC ACT 2001

4 PERFORM ACHIEVE & TRADE

National Mission on Enhanced Energy Efficiency (NMEEE) is one of the eight missions which formed India's National Action Plan on Climate Change (NAPCC).

OBJECTIVE



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KEY PROVISIONS OF EC ACT 2001

Concept of Target, Compliance, ESCerts and Penalty

4 PERFORM ACHIEVE & TRADE

- PAT mandates specific energy efficiency improvements for the most energy intensive industries.
- The scheme is based on the wide variations in specific energy consumptions (baseline SECs) of different units in each notified sector.
- The units in terms of SECs range from among the best in the world to some of the most inefficient units.

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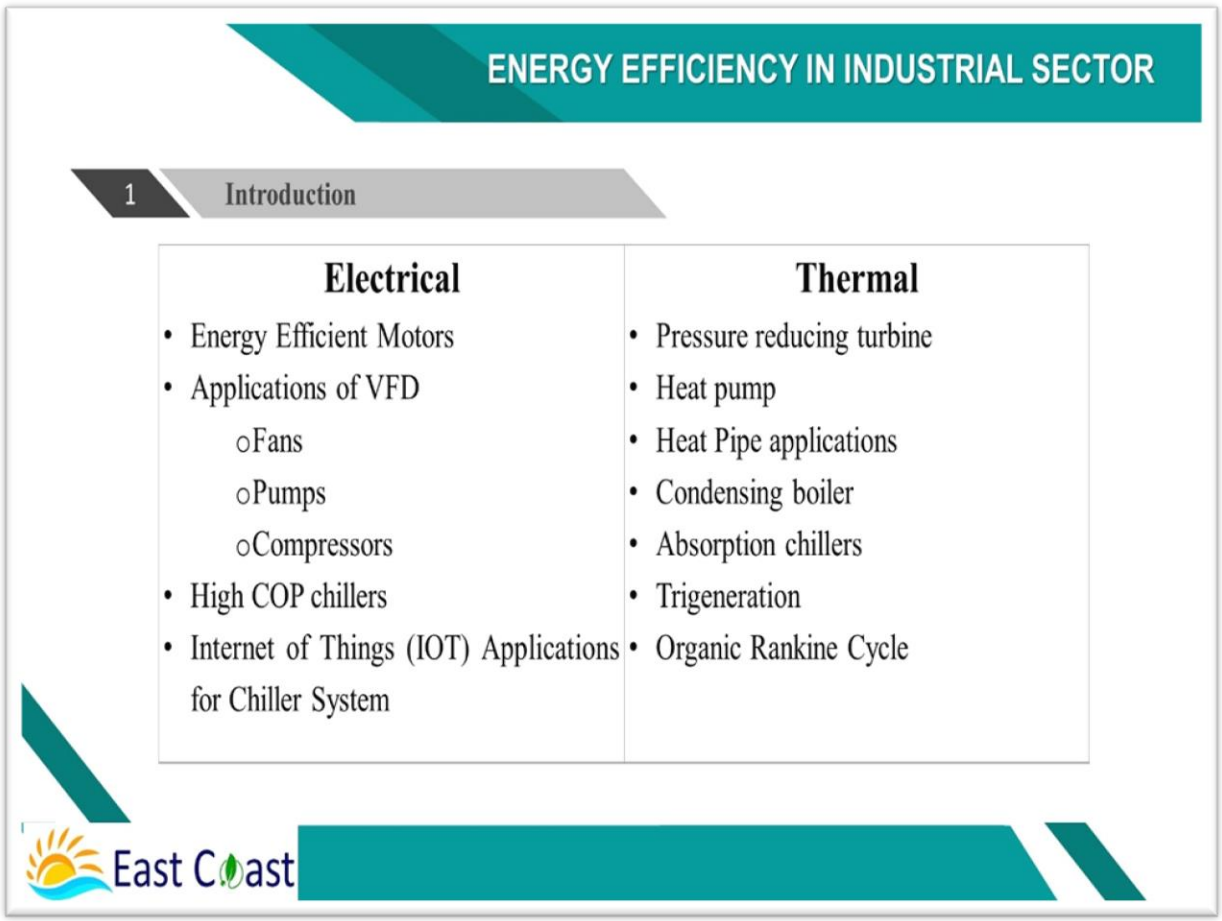
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR
East Coast


ENERGY EFFICIENCY IN INDUSTRIAL SECTOR
1 Introduction
Electrical
• Energy Efficient Motors
• Applications of VFD
oFans
oPumps
oCompressors
• High COP chillers
• Internet of Things (IOT) Applications for Chiller System
Thermal
• Pressure reducing turbine
• Heat pump
• Heat Pipe applications
• Condensing boiler
• Absorption chillers
• Trigeneration
• Organic Rankine Cycle
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ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

2 Energy Efficient Motors

Class Type	Class Number
Standard efficiency	IE1
High efficiency	IE2
Premium efficiency	IE3
Super premium efficiency	IE4

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ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

2 Replacing IE1 motor with IE3

The information regarding the old motor and the operation pattern is as follows:

Rated Power	37 KW
No. of Poles	4
Efficiency	91.2 (IE1)
Operating hours per day	10
Operating days per year	360

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ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

2 Replacing IE1 motor with IE3

The annual energy consumption is calculated as follows:

- Annual Energy Consumption (kWh per Year) =
- 37 kW/0.912 x 10 hours per day x 360 days/ year = 1,46,052 kWh
- It is proposed to replace IE1 is replaced with IE3 motor as per following specifications:

Rated Power	37 KW
No. of Poles	4
Efficiency	93.9 (IE3)
Designed lifespan	400,000 hours

- The percentage of energy-saving and the anticipated annual energy saving is calculated below:

$$\text{Percentage of energy savings (\%)} = \left(1 - \frac{91.2}{93.9}\right) \times 100\% = 2.88\ \%$$

Annual Energy Savings (kWh per year) *= 1,46,052 kWh per year x 2.88 / 100 =* ***4206 kWh / year***

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ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

2 Replacing IE1 motor with IE4

If the new motor is IE4 with following specifications, energy savings is as follows:

Rated Power	37 KW
No. of Poles	4
Efficiency	95.2 (IE4)
Designed lifespan	400,000 hours

- The percentage of energy-saving and the anticipated annual energy saving is calculated as follows:

$$\text{Percentage of energy savings (\%)} = \left(1 - \frac{91.2}{95.2}\right) \times 100\% = 4.22\ \%$$

Annual Energy Savings (kWh per year) *= 1,46,052 kWh per year x 4.2 % =* ***6134 kWh / year***

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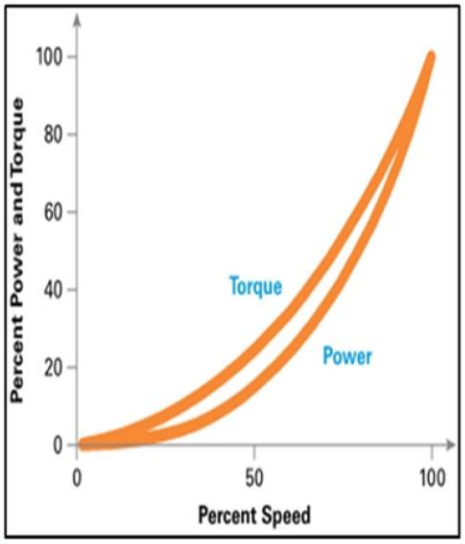
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR



3 VFD-Variable Torque Load

Variable Torque loads are typical of centrifugal fans and pumps and have the largest energy saving potential. They are governed by the Affinity Laws which describe the relationship between the speed and other variables:

- The change in flow varies in proportion to the change in speed: $Q1/Q2 = (N1/N2)$
- The change in head (pressure) varies in proportion to the change in speed squared: $H1/H2 = (N1/N2)2$

The change in power varies in proportion to the change in speed cubed : $P1/P2 = (N1/N2)3$

Where, Q = volumetric flow, H = head (pressure), P = power, N = speed (rpm)

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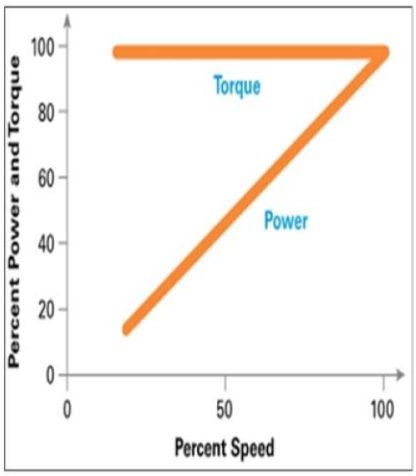
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR



3 VFD-Constant Torque Load

Typical constant torque applications include conveyors, agitators, crushers, positive displacement pumps and air compressor. On constant torque loads the torque remains constant with speed and the power absorbed is directly proportional to the speed this means that the power consumed will be in direct proportion to the useful work done, for example a 50% reduction in speed will result in 50% less power being absorbed or consumed.

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ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

3 VFD CASE STUDY

SLNo	Location	Units	VRM Raw mill Fan With GRR	VRM Raw mill Fan With VFD
1	Design Flow	M3/Hr	580000	580000
2	Design Total Head	mmWG	919	919
3	Inlet Damper Position	%	100	100
4	Speed Control Type		GRR	VFD
5	Gas Temperature	°C	90	90
6	Volume of gas	m3/s	135.48	135.48
		m3/Hr	487738	487738
		Nm3/Hr	335640	335640
7	Head Developed by the Fan	mmWG	785	785
8	Motor Rated Output Power	kW	2050	2050
9	Motor Rated Efficiency	%	95	95
10	Measured Input Power before VFD/GRR	kW	1522	1424
11	VFD Loss/GRR Loss	kW	155	57
12	Motor Input Power	kW	1367	1367

Replacing GRR control with VFD for Raw Mill Fan drive		
Parameter	**Unit of measurement**	**Value**
Present flow handled by Raw Mill fan	m3/hr	487738
Present head developed by Raw Mill fan	mmWC	785
Present Motor Input Power	kW	1367
Present GRR loss	kW	155
Estimated VFD loss	kW	57
Additional power saved due to smooth control with VFD	kW	68
Total Power savings	kW	166
Operating Hours	Hr/year	4000
Annual Energy Savings	kWh/year	665567
	MU/year	0.67

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ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

4 High COP Chillers

- Vapour compression chillers are used extensively for large facility space cooling and in industrial process liquid cooling.
- Improving chiller efficiency can significantly reduce energy usage.
- A liquid chilling system cools water or secondary coolant for air conditioning or process refrigeration.
- A chiller has four primary components: compressor, compressor drive, evaporator, and condenser.
- Chillers can be further categorized according to the type of compressor being used.
  - Reciprocating Compressor Chillers
  - Centrifugal Compressor Chillers
  - Screw Compressor Chillers
  - Scroll Compressor Chillers
  - Absorption Chillers

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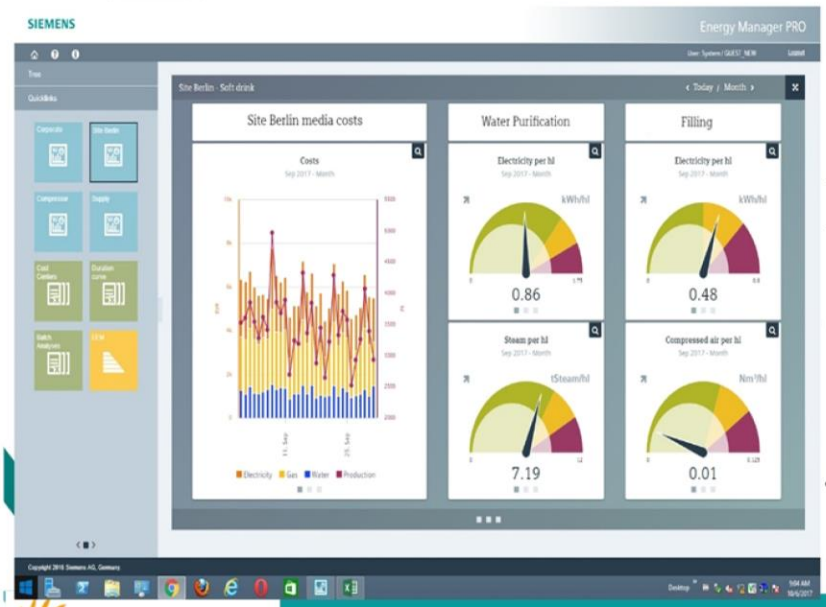
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

5 IoT & Energy Analytics



Here, the energy manager sees that the consumption of electricity per hl in the department "Filling" is also in the yellow range.

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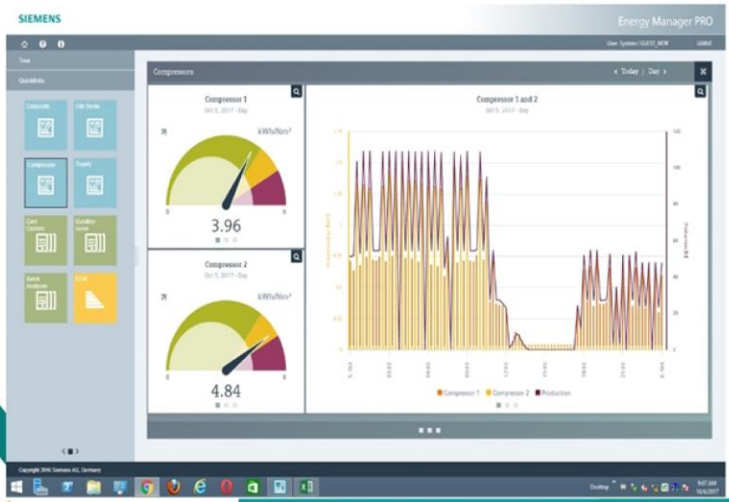
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

5 IoT & Energy Analytics

- Energy Analytics Visualization helping Decisions



More detailed review of the standby consumptions with the compressors dashboard. There the energy manager realizes:

- *Efficiency of the compressor 2 is substantially in the yellow range*
- *Efficiency of the compressor 1 in the green range*

→ Hence, compressor 2 is more inefficient compared to compressor 1.

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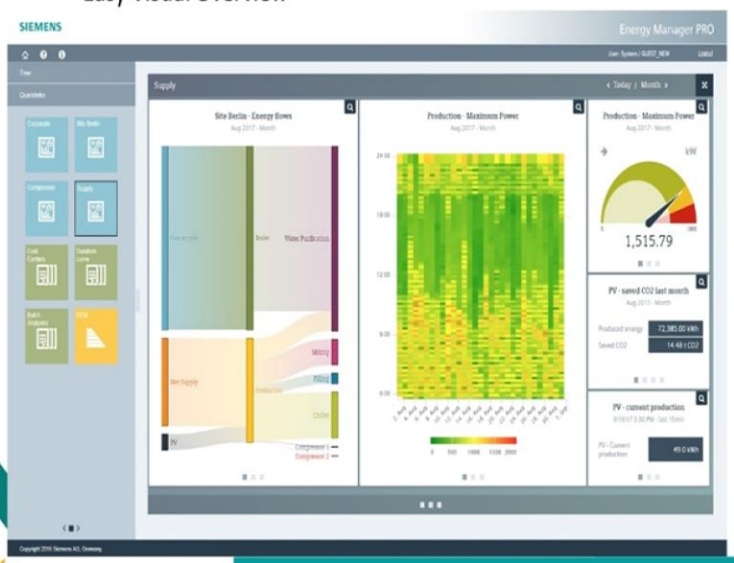
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

5 IoT & Energy Analytics

- Easy Visual Overview



This Dashboard offers the energy manager statements in order to review the contract with energy supplier:

- Power maximum (Gauge Widget)
- Distribution of peak loads (Carpet Plot)
- Amount of supplied electrical. energy and gas (Sankey Diagram)

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ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

5 IoT & Energy Analytics

- Cost Center report Distribution of the costs according to the causer

Consumption- and Cost overview

Author: ADMIN

Period: 01.07.2017 01.08.2017

Date: 08.29.2017 11:07

	Media	Unit	Total consumption	Soft drink production	Filling/Packaging	Utilities	Administration Building
	Soft drink factory consumptions						
CC 100% measured	Electricity	kWh	533.714,3	216.820,2	53.162,0	242.328,0	21.404,0
CC 100% measured	Gas	kWh	873.163,7	0,0	0,0	872.787,7	376,0
CC 100% measured	Water	m³	19.887.190,4	9.827.447,0	9.695.290,4	0,0	364.453,0
CC 100% measured	Sugar, aromatic incrediants	kg	1.091.944,0	1.091.944,0	0,0	0,0	0,0

	Media	Unit	Total costs	Soft drink production	Filling/Packaging	Utilities	Administration Building
	Soft drink factory costs						
CC 100% measured	Electricity	EUR	81.765,0	33.216,9	8.144,4	37.124,7	3.279,1
CC 100% measured	Gas	EUR	75.441,3	0,0	0,0	75.408,9	32,5
CC 100% measured	Water	EUR	39.774,4	19.654,9	19.390,6	0,0	728,9
CC 100% measured	Sugar, aromatic incrediants	EUR	436.777,6	436.777,6	0,0	0,0	0,0
		Sum	633.758,4				

The cost center report offers a fast overview about the energy- and media consumptions as well as the costs for each cost center. The overall costs of the lemonade factory are also calculated.

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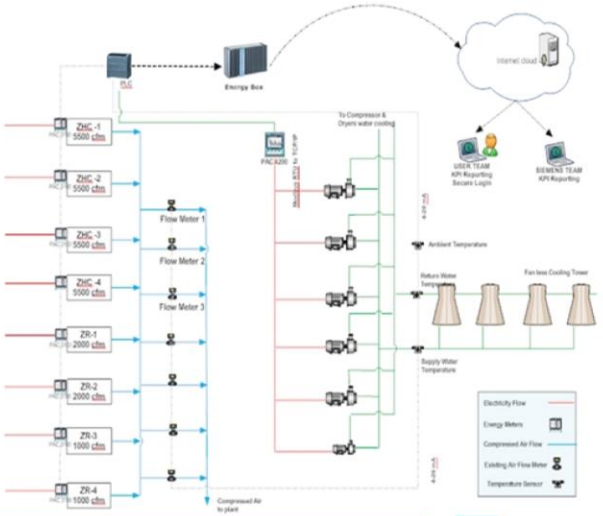
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

5 IoT & Energy Analytics

- Energy Analytics Use Case @ Utilities

Parameter	Measurement	Instrument	Communication	Sampling time
Active Energy, Reactive Energy	Compressor-1, Compressor-2, Compressor-3, Compressor-4, Compressor-5, Compressor-6, Compressor-7, Compressor-8, Total Pumping Power	Energy Meter PAC 3100 PAC 4200	Modbus RTU, TCP/IP	1 Minute
Compressed Air Flow	Air Flow Meter -1, Air Flow Meter -2, Air Flow Meter -3, Air Flow Meter -4, Air Flow Meter -5, Air Flow Meter -6, Air Flow Meter -7	Existing Air Flow Meter	4-20 mA	1 Minute
Cooling Tower range and approach	Supply Water Temperature, Return Water Temperature, Ambient Air Temperature	Temperature transmitters	4-20 mA	1 Minute
Common header Pressure	Prossure	Pressure Transmitter	4-20 mA	1 Minute



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ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

6 Pressure Reducing Turbine

- The steam pressure is generally throttled and controlled to reduce pressure using pressure reducing valves (PRV).
- The throttling process is isenthalphic which means enthalphy before and after throttling is constant, and no energy output can be produced.
- Alternatively, if pressure is reduced through turbine (backpressure type), energy can be produced along with low pressure steam for process. Although steam consumption is increased marginally, net energy savings can be achieved.

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ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

6 Case Study: Pressure Reducing Turbine Application

- Steam is generated in the boilers at pressure of 7 - 10.5 kg/cm2 and steam pressure is reduced in the PRV's/PRDS to lower pressure of 2.5 kg/cm2 to 3.0 kg/cm2 required for the process (refer figure on next slide).
- After installation of steam turbine, reduction of steam pressure in PRV's/PRDs is avoided and electrical power is produced from generator coupled to the turbine.
- Steam turbine is installed in parallel to PRV/PRDs, and steam energy which would have been wasted due to pressure reduction, is recovered in the form of electrical power, thus reducing power cost.

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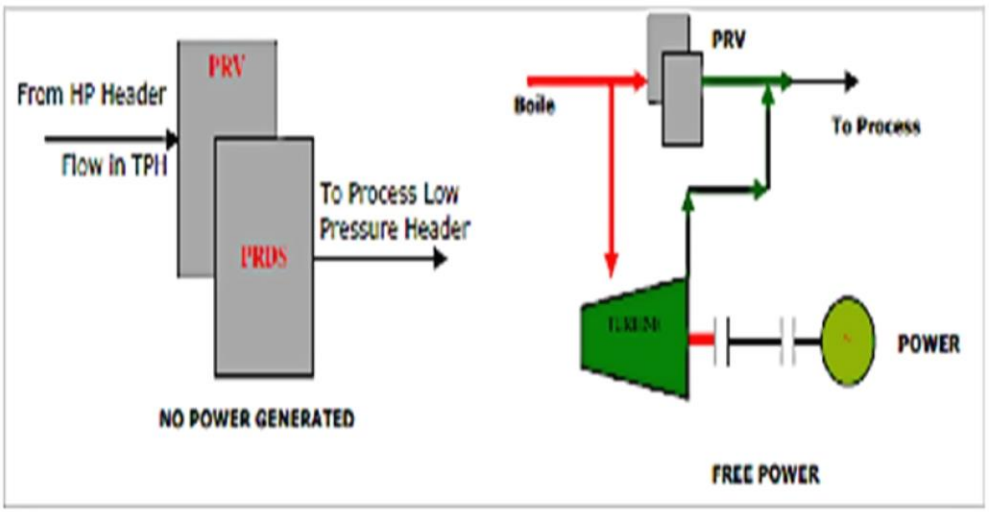
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

6 Case Study: Pressure Reducing Turbine Application



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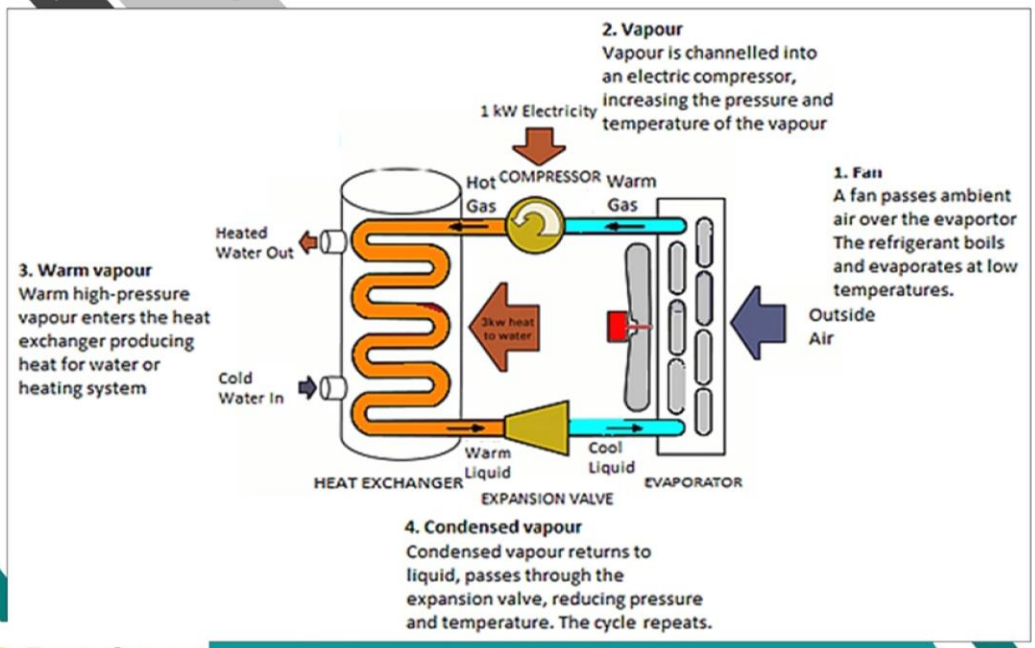
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

7 Heat Pump



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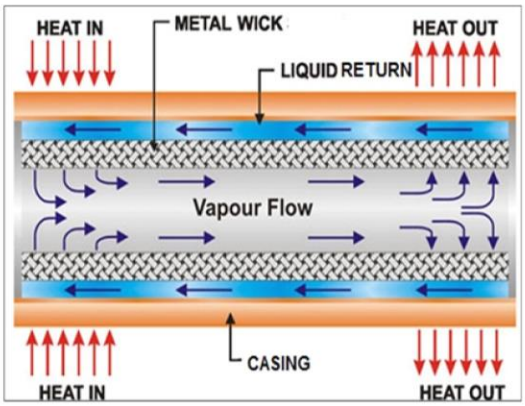
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

8 Heat Pipe



- Heat Pipes are devices which can transfer 1000 times more thermal energy than copper.
- Heat Pipe is basically a copper tube sealed on both ends with an internal wick or mesh along the interior of the pipe.
- The operating principle of heat pump is based on evaporation/condensing cycle.

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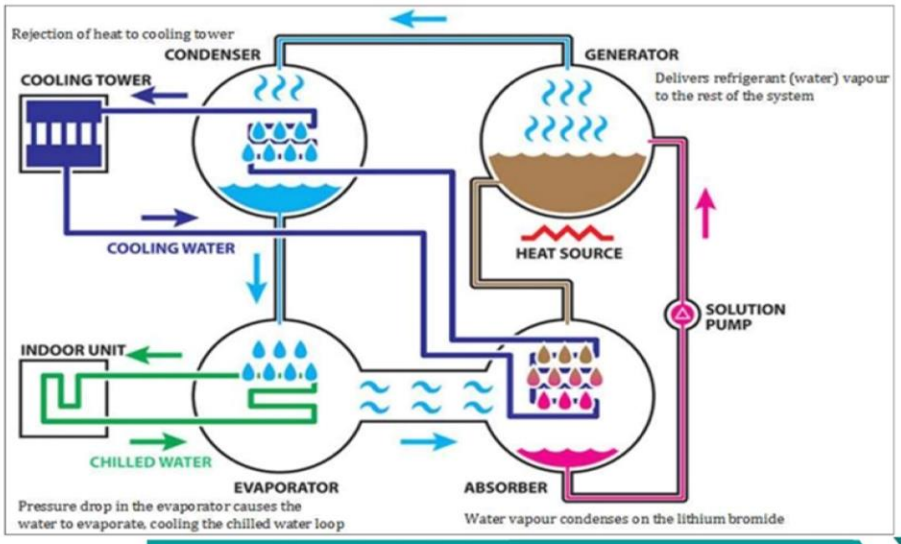
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

9 Vapour Absorption Machine



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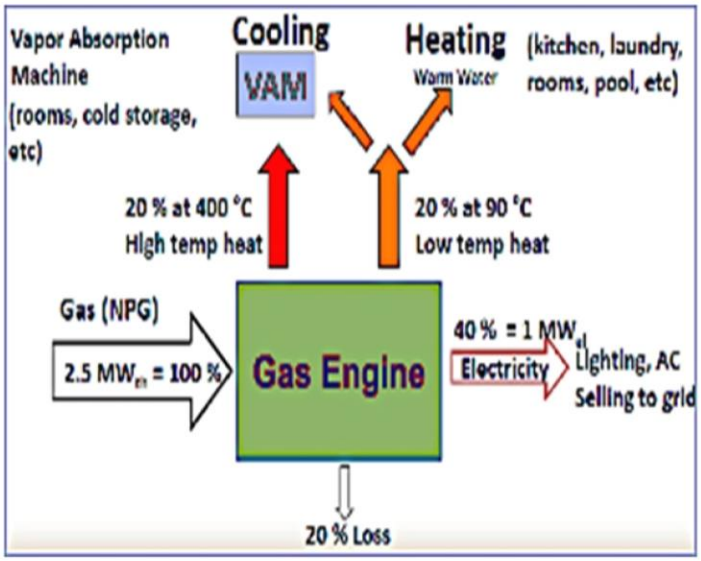
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

9 Trigeneration Application



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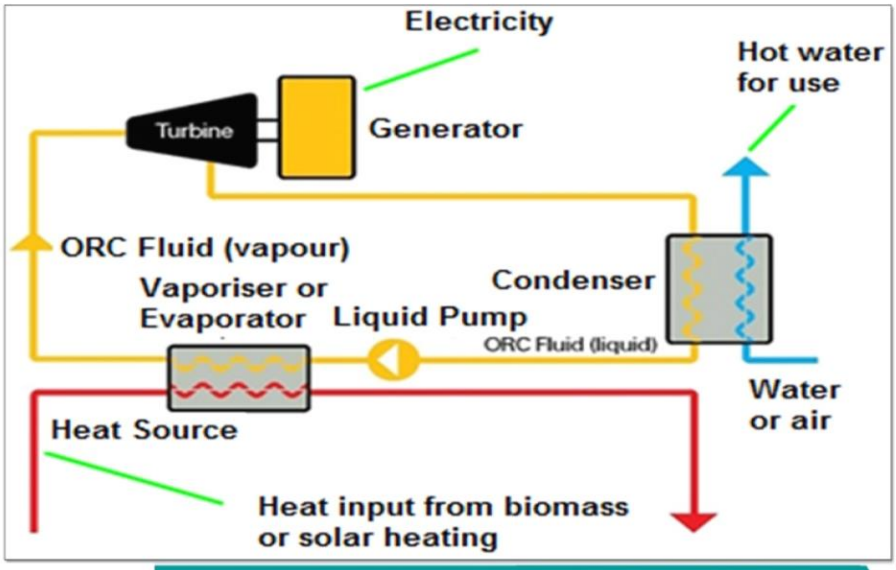
ENERGY EFFICIENCY IN INDUSTRIAL SECTOR

10 Organic Rankine Cycle



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ENERGY EFFICIENCY IN COMMERCIAL BUILDINGS

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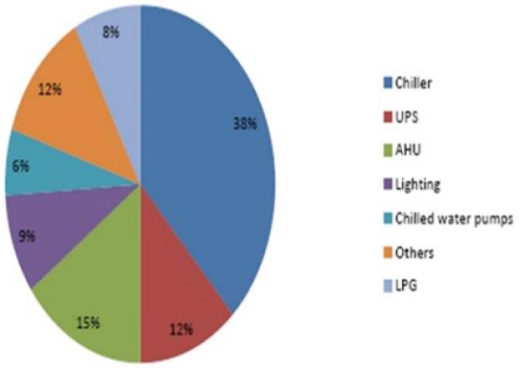
INTRODUCTION

1 Introduction

Energy Balance



- Large-scale urbanization and increasing income, and the construction industry growth rate in India is 10% as compared to the world average of 5.2%.
- Projected by 2030 that two-thirds of the buildings have yet to be built and 1 billion m^2 of new commercial buildings will be added.
- Commercial buildings are the third largest consumers of energy, after industry and agriculture.
- Buildings annually consume about 30–35% of electricity consumption in India.

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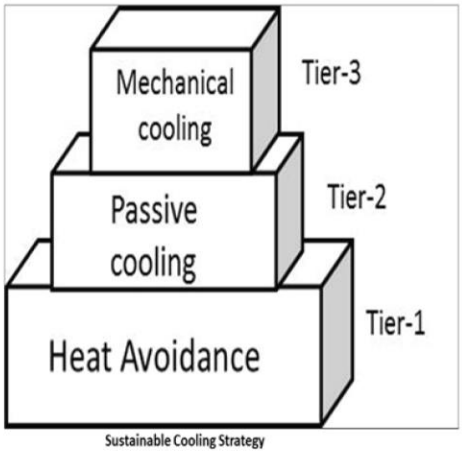
BUILDING AS AN ENERGY SYSTEM

2 Building Energy System



Sustainable Cooling Strategy

- The Energy Auditor needs to look holistically at the building when recommending efficiency measures to ensure that these energy interactions are taken into account.
- As using passive methods for cooling, the most sustainable approach would be adopting three-tier approach with heat avoidance being the first preference, followed by passive cooling, and mechanical cooling as shown in Figure

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ECBC

Hospitality
Star/non Star Hotels, Resorts

Religious, Recreation, Social,
Picture hall, Bus/Rail/Airports

Healthcare

Educational

3 Building Classification

The following are the classifications of building as per ECBC:

- Hospitality: Star/non Star Hotels, Resorts
- Healthcare
- Assembly: Religious, Recreation, Social, Picture hall, Bus/Rail/Airports
- Business: Large >30000 sq.m, Medium: <30000 - 10000 Sq.m, small <10000 Sq.m
- Educational
- Shopping Complexes
- Mixed Building

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ECBC

3 Levels of Energy Efficiency Performance

- **ECBC Buildings**

  Demonstrate compliance by adopting the mandatory and prescriptive requirements listed under ECBC Compliant Building requirements. An ECBC compliant new building should be able to demonstrate minimum **energy savings of 25%** compared to a conventional building.

- **ECBC+ Buildings**

  Shall demonstrate compliance by adopting the mandatory and prescriptive requirements listed under ECBC+ Compliant Building requirements. Buildings should be able to demonstrate **energy savings of 35%** compared to a conventional building.

- **SuperECBC Buildings**

  Shall demonstrate compliance by adopting the mandatory and prescriptive requirements listed under SuperECBC Compliant Building requirements. Buildings should be able to demonstrate **energy savings of 50%** compared to a conventional building.

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ENERGY SAVING APPROACHES FOR BUILDING

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ENERGY SAVING APPROACHES FOR BUILDING

4 Energy Saving Approaches

- Some of the key Energy Efficiency Measures covering building envelope (Walls, Roofs, Windows), Heating Ventilation and Air Conditioning (HVAC) System, Lighting (indoor and outdoor), and Electrical Power and Motors are briefly described as follows:

4.1 Passive Designs

- Passive designs take advantage of local climates and reduce energy consumption for heating or cooling the building by optimizing insulation, ventilation, orientation, and shade of a building.
- Some Steps can be used Energy Saving Approach:
  - ✓Form and Orientation
  - ✓Minimizing Heat Gain through roofs
  - ✓Fenestration
  - ✓Low Energy Cooling

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ENERGY SAVING APPROACHES FOR BUILDING

4.2 HVAC

- HVAC systems contribute to nearly 40% of the energy used by commercial buildings and over 50% of total energy consumption in IT buildings.
- The HVAC system types are broadly categorized as follows:
  - ✓Centralized system: Central Chilled Water System (Air cooled and water cooled)
  - ✓Distributed system (DX system): VRF, Duct able system, split air conditioners, unitary systems

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ENERGY SAVING APPROACHES FOR BUILDING

4.2 HVAC

- Energy saving potential in HVAC System Design is shown in Table

Component	Cooling Load (kW/ton)		Improvement Potential
	Conventional Design	Optimized Design	
Chiller	0.75	0.50	33%
Air Distribution System	0.60	0.06	90%
Water Pump	0.30	0.04	87%
Cooling Tower	0.10	0.02	80%
Total	1.75	0.62	65%

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ENERGY SAVING APPROACHES FOR BUILDING

4.3 Other Approaches

- Air tightness
- Mixed Mode Ventilation System
- Demand-Controlled Ventilation (DCV)
- Electronically Commutated Fans
- Low-temperature Variable Air Volume
- Heat Recovery Ventilation ('HRV') systems
- Solar Cooling
- Insulated roller doors
- Lighting
  - LED Lighting
  - Occupancy Detection
  - Daylight Dimming
  - Flexible Lighting Control
- Building integrated photovoltaic ('BIPV')
- Solar hot water systems
- Sub-metering systems
- Energy Efficient Appliances
- Electrical Energy Storage
- Building Energy Management System ('BEMS')
- Crystalline Water proofing
- BM Analytics
- Self-Learning Buildings
- Use of simulation for energy efficiency in building
- Green Leasing

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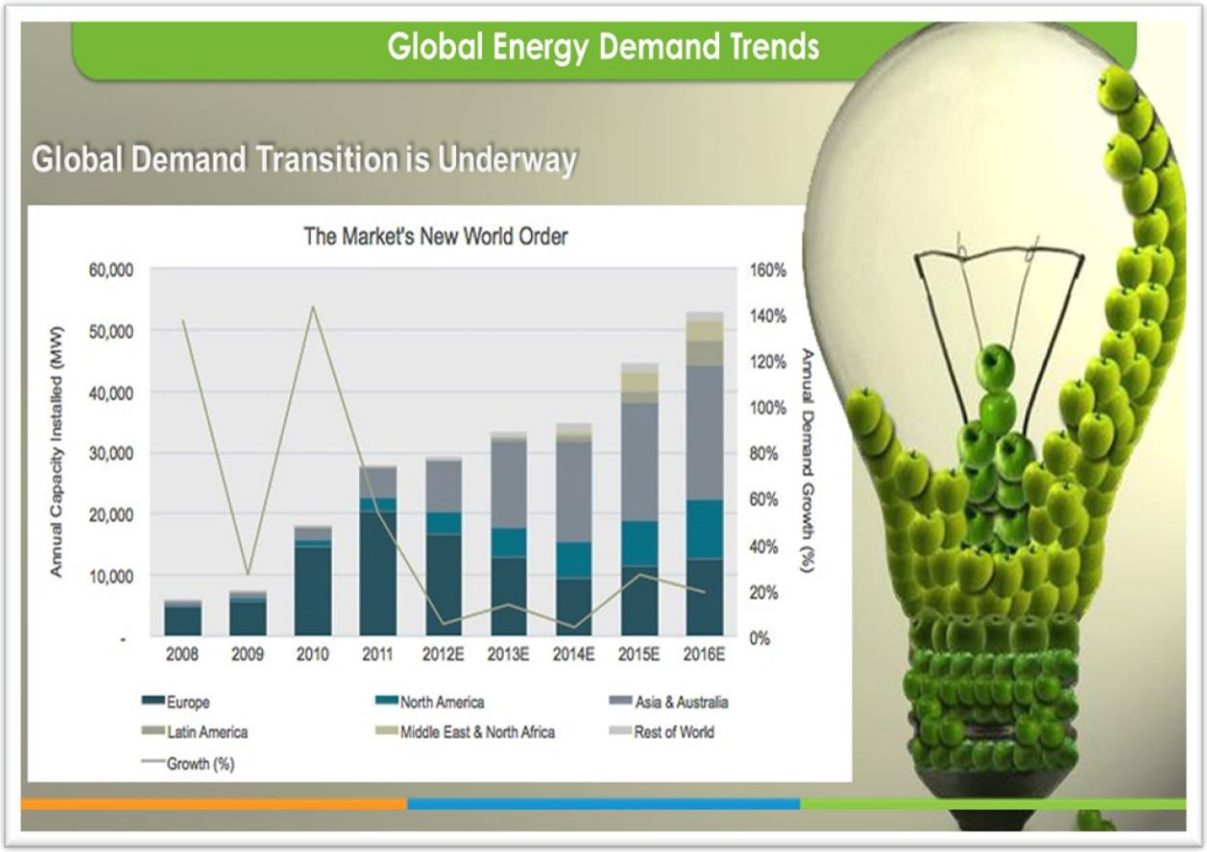
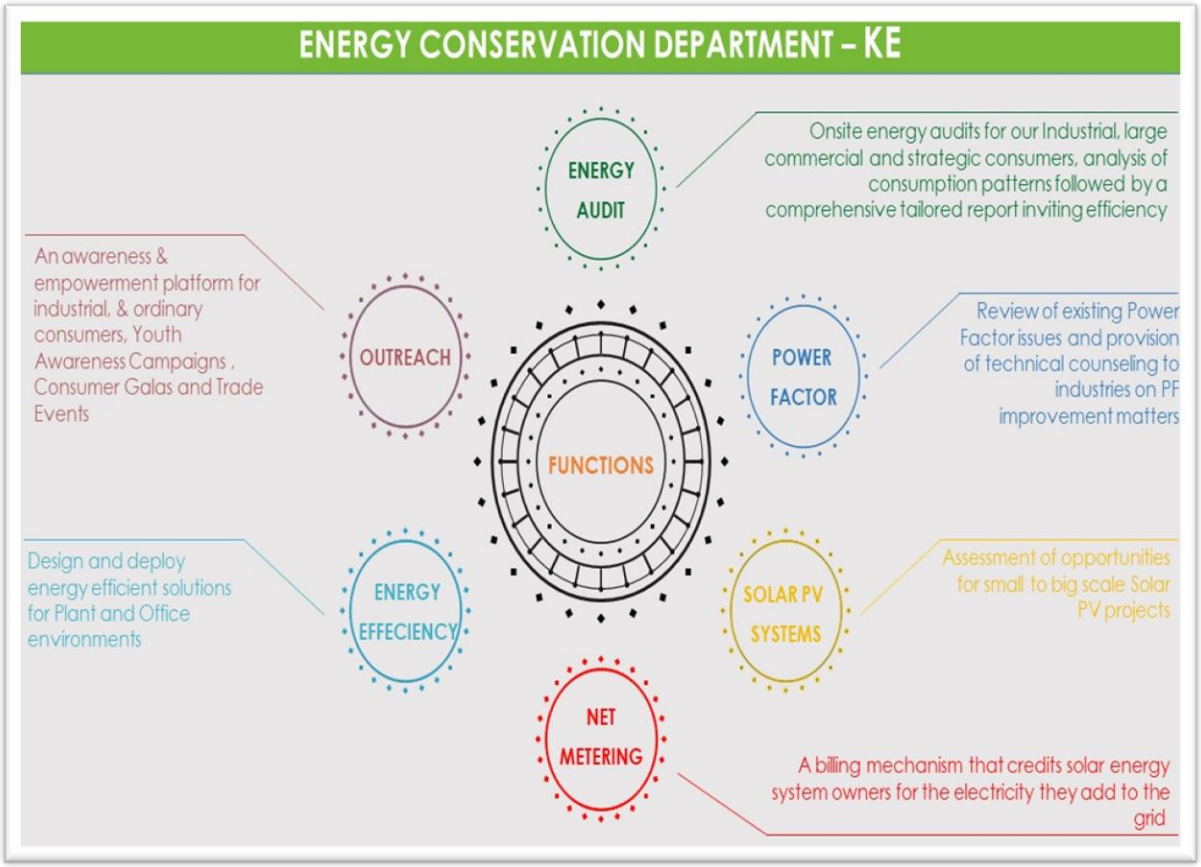
Email: srinivasa.gandepalli@eastcoast.net.in, business@eastcoast.net.in

2. "Energy Efficiency" by Mr. Syed Waqas Arshad,
Lead Energy Conservation, K-Electric, Pakistan.



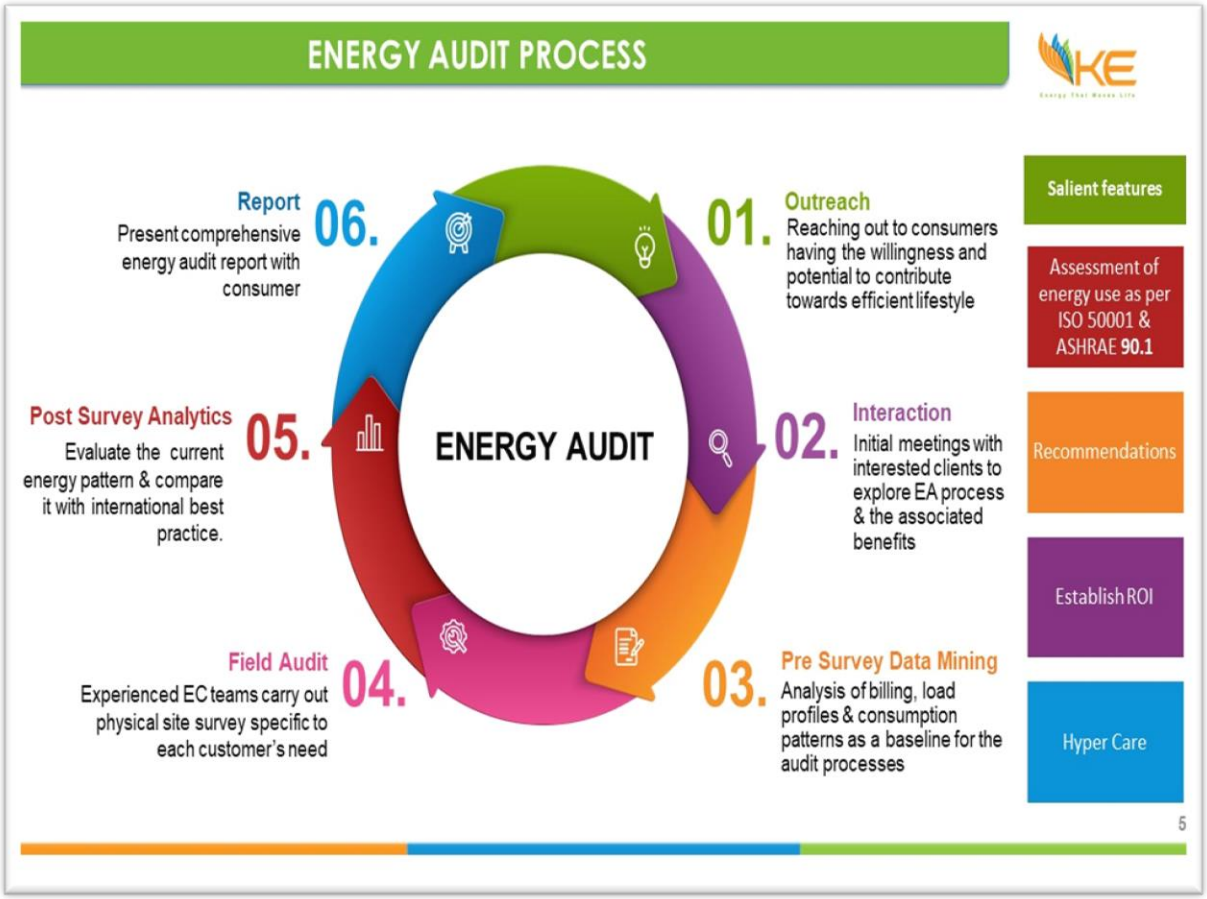


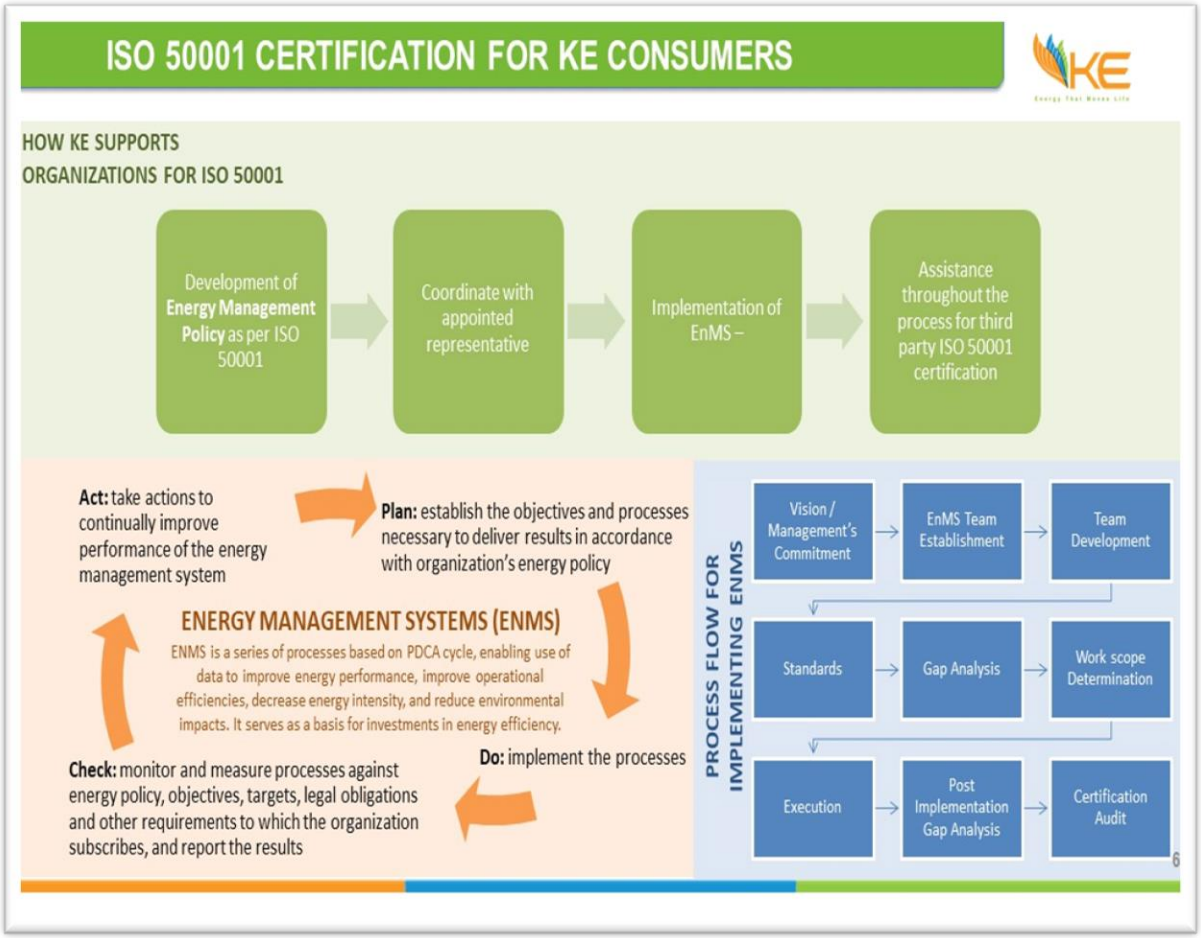
What is Energy Efficiency..??

- Reduced **Energy Waste**; Using less energy to perform the same task
- Reduced **Greenhouse Gas Emissions** and **Demand for Energy Imports**
- O&M and **Energy Management Plan** ensuring **Sustained Savings** and **Enhanced Performance Standards**

Technological Advancements in Industrial & Commercial Sectors

- Lightings
- Air conditioning (Inverters & VRF)
- Efficient solutions for high inductive loads (Motors/Comp/Heaters)
- Alternate energy sources (Wind/Solar)
- Process automation leading to higher efficiency
- Heat Rejection/Rooftop Insulation
- Smart Building MS – Automation & Monitoring


ENERGY AUDIT PROCESS
ENERGY AUDIT
01. Outreach
Reaching out to consumers having the willingness and potential to contribute towards efficient lifestyle
02. Interaction
Initial meetings with interested clients to explore EA process & the associated benefits
03. Pre Survey Data Mining
Analysis of billing, load profiles & consumption patterns as a baseline for the audit processes
04. Field Audit
Experienced EC teams carry out physical site survey specific to each customer's need
05. Post Survey Analytics
Evaluate the current energy pattern & compare it with international best practice.
06. Report
Present comprehensive energy audit report with consumer
Salient features
Assessment of energy use as per ISO 50001 & ASHRAE 90.1
Recommendations
Establish ROI
Hyper Care
5


ISO 50001 CERTIFICATION FOR KE CONSUMERS
HOW KE SUPPORTS ORGANIZATIONS FOR ISO 50001
Development of Energy Management Policy as per ISO 50001
Coordinate with appointed representative
Implementation of EnMS –
Assistance throughout the process for third party ISO 50001 certification
Act: take actions to continually improve performance of the energy management system
Plan: establish the objectives and processes necessary to deliver results in accordance with organization's energy policy
ENERGY MANAGEMENT SYSTEMS (ENMS)
ENMS is a series of processes based on PDCA cycle, enabling use of data to improve energy performance, improve operational efficiencies, decrease energy intensity, and reduce environmental impacts. It serves as a basis for investments in energy efficiency.
Do: implement the processes
Check: monitor and measure processes against energy policy, objectives, targets, legal obligations and other requirements to which the organization subscribes, and report the results
PROCESS FLOW FOR IMPLEMENTING ENMS
Vision / Management's Commitment
EnMS Team Establishment
Team Development
Standards
Gap Analysis
Work scope Determination
Execution
Post Implementation Gap Analysis
Certification Audit
6

CLIENTS WORKED WITH

Some Strategic handshakes

Energy Audits
500+ energy audits conducted
60 MW saved
162,675 tons of CO2 reduced

Governor House 61 kW	CM House 347 kW	Sindh Assembly 228 kW	Sindh Secretariat 143 kW	Sind Club 380 kW	151 kW	IBA 478 kW	Meezan Bank 65 kW
ICAP 58 kW	SGS 60 kW	NEDUET 600 kW	Marie Adelaide 27 kW	Dawlance 460 kW	Hilton Pharma 96 kW	Asia Petroleum 267 kW	KGS 416 kW
PSO 2300 kW	General Tyre 300 kW	280 kW	Lady Dufferin Hospital 33 kW	Brookes 44 kW	38 kW	HBL 210 kW	110 kW

7

SMALL SCALE RENEWABLE ENERGY STRATEGIC CLIENTS

947 kW Projects Completed

1,540 kW Projects Counseled

785.45 tons of CO2 p.a. reduced

Over **2.5 MW** consultancy provided

Asia Petroleum 360 kW	Hilton Pharma 55 kW	PSO Pakistan State Oil 407 kW	Total 143 kW	102 kW	Karachi Grammar School 150 kW
GlaxoSmithKline Pakistan 110 kW	Brookes 10 kW	Chief Minister House 35 kW	SINA 5 kW	IBA 600 kW	KE 350 kW

RAJBY TEXTILE INDUSTRY

ENERGY EFFICIENCY TARGETS	Potential energy savings	Potential financial savings	Potential CO2 reduction
	25% optimization per year	1.5 million rupees per year	32 metric tons per year

Before audit → **46,116 kWh** Monthly average units consumed

After Audit → **39,118 kWh** Monthly average units consumed

6,998 kWh Per month savings

PKR 500,000 Investment

10

ASIA PETROLEUM INDUSTRY

ENERGY EFFICIENCY TARGETS	Potential energy savings	Potential financial savings	Potential CO2 reduction
	38% optimization per year	2.5 million rupees per year	128 metric tons per year

Before Audit → **234,509 kWh** Monthly average units consumed

After Audit → **157,654 kWh** Monthly average units consumed

→ **76,855 kWh** Per month savings

11

ORIX LEASING

ENERGY EFFICIENCY TARGETS	Potential energy savings	Potential financial savings	Potential CO2 reduction
	34% optimization per year	6.9 million rupees per year	128 metric tons per year

Before Audit → **45,633 kWh** Monthly average units consumed

After Audit → **42,459 kWh** Monthly average units consumed

→ **3,174 kWh** Per month savings

PKR 300,000 Investment

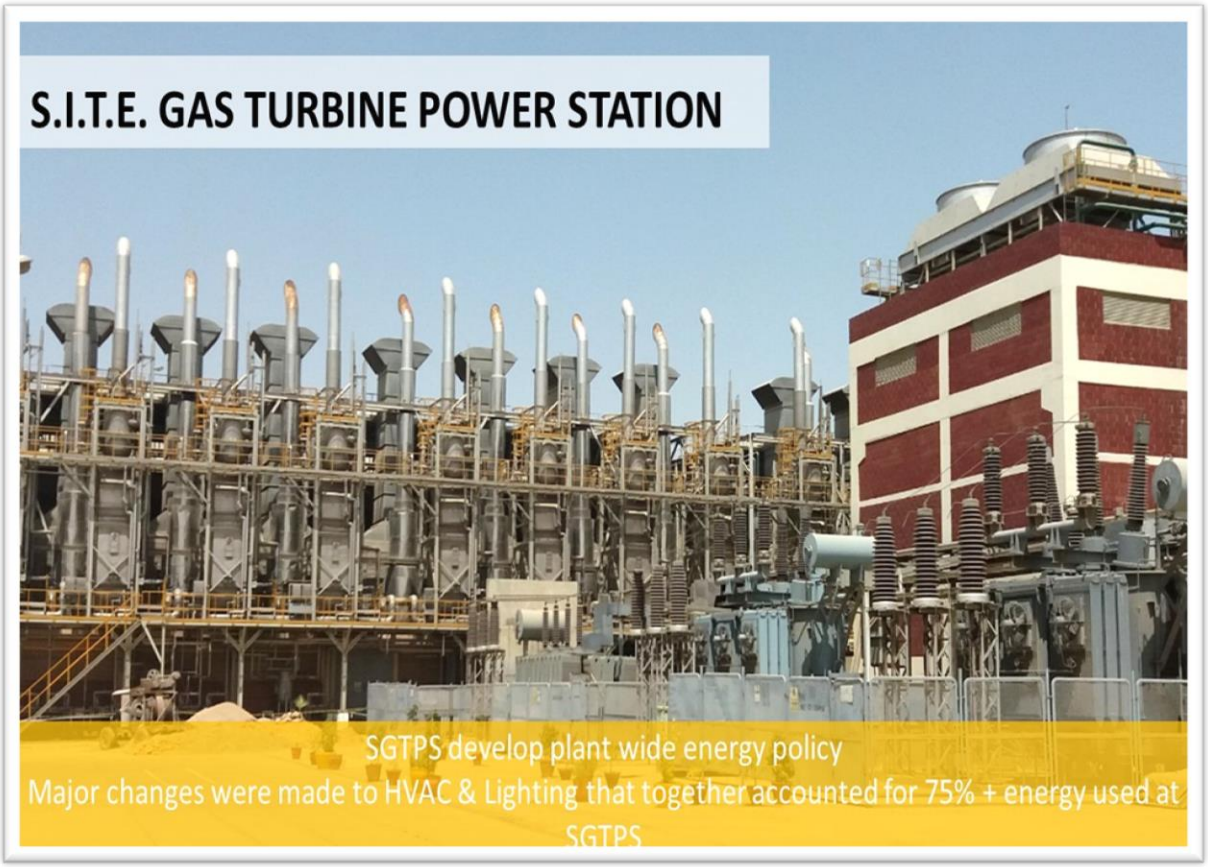
12

EC Awareness Sessions

- Technical sessions for our industrial and commercial consumers.


Bin Qasim Power Station - II
At BQPS-II...
• First ever plant in Pakistan to achieves ISO 50001 certification.
Gross installed capacity of 248 MW 8% total plant auxiliary power consumption.
BQPS II used the vision and insight of KE energy conservation to develop and roll out and EnMS as per ISO 50001 guidelines.


KORANGI POWER COMPLEX
KPC used the vision and insight of KE energy conservation to develop and roll out and EnMS as per ISO 50001 guidelines.
KPC has developed a plant-wide energy policy, and made major changes in lighting and AC.

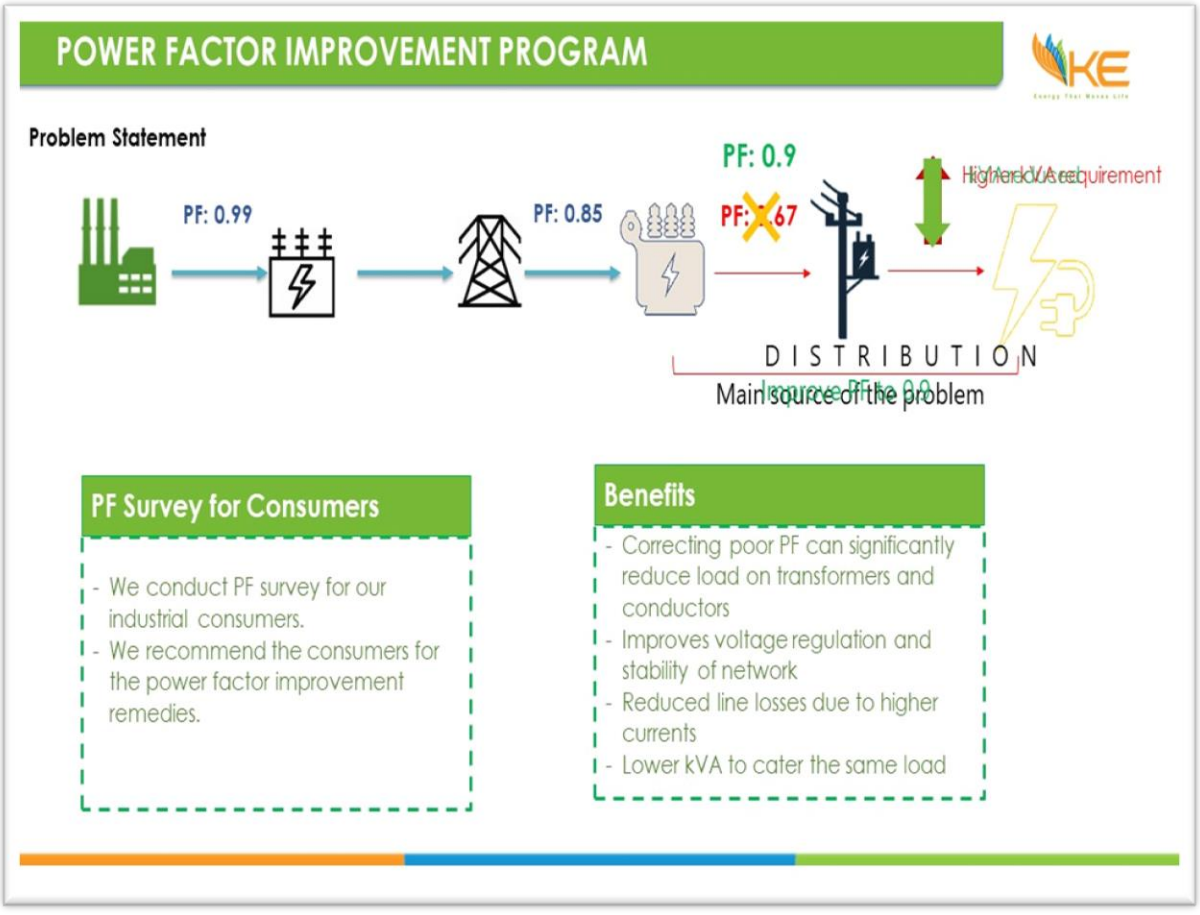

S.I.T.E. GAS TURBINE POWER STATION
SGTPS develop plant wide energy policy
Major changes were made to HVAC & Lighting that together accounted for 75% + energy used at SGTPS


TRANSFORMER SWITCHGEAR WORKSHOP
TSW through energy policy implementation achieve energy efficiency in its process areas.
Load optimized by the maintaining of PF, installation of VFDs, Inverter and LED technologies.
Installing 300 kW solar PV system.


ITG & PROCUREMENT BUILDING OF KE
AUTOMATION SYSTEM SAVING 20,000+ MONTHLY ENERGY UNITS
D
KE IT & procurement building have been achieved energy efficiency through installation of building automation system.
30% reduction in energy consumption in both buildings by automation system.


Features...
• Complete system designed in-house
• State of the art structure
• Annual production target of 302,000 kWh exceeded
350 kW Solar Carport at KE head office


Features...
• More than 60% load catered through Solar
• Schneider's BMS
• LEED Gold Certification through USGBC
K-ELECTRIC
The New KE Bill Simple and Easy to Understand
CLICK HERE
First Full Green LEED Gold Certified Building in KE


POWER FACTOR IMPROVEMENT PROGRAM
Problem Statement
PF: 0.99
PF: 0.85
PF: 0.9
PF: 0.67
Higher kVA requirement
DISTRIBUTION
Main source of the problem
PF Survey for Consumers
- We conduct PF survey for our industrial consumers.
- We recommend the consumers for the power factor improvement remedies.
Benefits
- Correcting poor PF can significantly reduce load on transformers and conductors
- Improves voltage regulation and stability of network
- Reduced line losses due to higher currents
- Lower kVA to cater the same load

ENERGY SAVING TIPS FOR INDUSTRIAL CONSUMERS

Use LED lighting.
Payback – 1 to 2 months

In industrial buildings, lighting accounts for approximately **10%-20%** of the total energy used. Deploying efficient lamp technologies such as LEDs can increase savings by **80%**.

Implement Process Automation and Energy Management System.
Payback – 1 to 4 years

Improved automation in plants can save up to **80%** energy. It can increase productivity, decrease downtime and minimise maintenance requirements while reducing energy consumption. Automation also aids in data collection for metering and instrumentation required for the Energy Management System.

Use high efficiency motors with Variable Speed Drives.
Payback – 3 to 12 months

Motors are very energy-intensive. Energy-efficient motors pay back their purchase price within a few months.

Small reductions in the speed of Variable Speed Drives (VSDs) can optimise the voltage and frequency supply to the motor. Matching the speed of the motor to the actual load demand can produce significant energy savings. An effective motor management policy with VSDs can be implemented, resulting in further savings.

Install efficient heating and cooling technology.
Payback – 2 to 5 years

Heating and cooling use around **20%-40%** of a building's energy. Replacing old boilers and chillers with modern versions can reduce energy usage.

A modern condensing boiler operates at an efficiency of **95%**, whereas a conventional boiler has an efficiency of only **80%**. A recommended chiller's Coefficient of Performance (COP) should be around 6. A higher COP figure means less energy is required — thus, reducing costs.

Improve power controls and power factor.
Payback – 1 to 4 years

Power factor correction can improve the usable power available to the equipment, thus, maximising its efficiency. Recommended power factor as per NEPRA guidelines is 0.9. Power Factor Improvement panels can:

- Increase current carrying capacity of the factory's electrical network.
- Stabilise network voltage.
- Decrease the electricity bill by avoiding low power factor penalties.

Active Harmonic Control removes noise from power lines while saving energy and reducing deterioration of electrical equipment. By scheduling production during off-peak hours and managing electricity tariffs, you can use energy when it is cheaper.

K-Electric has taken a special initiative to address the issue of low power factor which is the root cause of additional penalties in your monthly bills.

Power Factor is defined as the ratio between active power and apparent power. It must be maintained up to a value of 0.95.

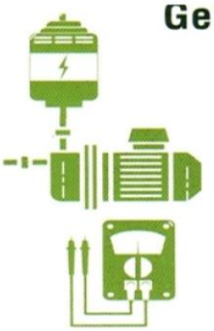
The correct value of power factor can save you from paying monthly penalties and enable us to reduce overloading of network infrastructure, and enhance system capacity.

Steps that can be taken to improve Power Factor:

Immediate Steps

1. Installation of capacitor banks
2. Adequate sizing of capacitor banks according to load
3. Proper switching mechanism for supply of adequate reactive power

Note:
The capacitor size should be kept at a minimum of 7.5 or 12.5 KVAR at first and last stages.



General Guidelines

1. Use branded motors and avoid using rewound motors.
2. Replace standard motors with energy-efficient motors.
3. Use synchronous motors instead of induction motors.
4. Minimise operation of idling or lightly loaded motors.
5. Avoid operation of equipment above its rated voltage.
6. Vendor should be PEC registered.

Consumers can approach our energy conservation department for guidance and determination of best options including the following services:

Contact details are given at the back.

1. Technical assistance in PF determination and counselling sessions
2. Fault diagnosis of existing capacitor banks
3. Recommendations and implementation strategies for PF improvement

Once your power factor is maintained between **0.9 and 1.0**, the quality of power supply to your premises will be greatly improved. It will further result in a **reduction of tripping cases** and complaints, **improvement in voltage stability**, **improvement in energy efficiency and life of appliances**, and last but not least the elimination of power factor penalties.

ENERGY SAVING TIPS FOR COMMERCIAL CONSUMERS

Use LED bulbs instead of CFLs or conventional incandescent bulbs.
LED lights can save up to **60%** load on average and last up to 10 times as long as conventional incandescent lights.

Use inverter ACs instead of conventional ACs.
Inverter ACs can save up to 50% AC load i.e. 1440 kWh per year. When purchasing an inverter AC, opt for DC inverter based components. Set your AC thermostat settings between 24°C and 26°C.

Switch off, unplug and save.
Turn off unnecessary appliances such as lights, fans, and ACs, especially during peak hours. Appliances continue to consume energy on standby mode.

Use motion sensor switches and timers.
Install motion sensors and timers to avoid leaving electrical appliances switched on around the clock.

Heat Rejection Sheets.
Use Heat Rejection Window Sheets. These sheets allow maximum sunlight to enter the building while simultaneously blocking heat, creating a comfortable working environment and saving electricity costs.

Energy Efficiency at Workplace

2-year payback

80% less heat & glare

30% off HVAC energy costs*

*HVAC: Heating, Ventilation and Air Conditioning

KE

Energy That Moves Life

Thank you

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